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**Crossing the Next Frontier: Precedents for a  
National Space Program from the History of the United States**

NASA History Division

September 1988

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Throughout our history the federal government has actively supported the exploration of our national frontiers. It has also administered and funded programs to develop the transportation and energy networks essential to the nation's economic growth and security. A federal role in national exploration and development is implicitly warranted in the U.S. Constitution, which empowers the federal government to make and execute those laws necessary to "promote the general Welfare" (Preamble). In addition, the power to "regulate Commerce with foreign Nations, and among the several States," "fix the Standard of Weights and Measures" and "to promote the Progress of Science and Useful Arts" through federal patents have been cited as constitutional grounds for federal programs to foster commerce and manufacturing (Article I, Sect. 7). The following is a brief description of some examples of the federal government's past role in national exploration and development.

Exploration

**U.S. Census (1790 -):**

The first federally conducted "exploration" was the decennial U.S. Census, required by the Constitution (Article I, Sect. 2) and taken in 1790 in order to apportion the number of representatives to the Congress and provide the basis for the

levy of direct taxes. While we rarely think of a census as a scientific exploration, the U.S. census has become fundamentally no different than a topographical or biological survey, for it has evolved into a periodic reconnaissance of the demographic, social, and economic composition of American society. The census has thus become an important tool of national public policy.

**Lewis and Clark Expedition (1803):**

Acutely aware of the equation between geographical knowledge and power in an era of imperial rivalries, President Thomas Jefferson in 1803 asked the U.S. Congress in a secret message for authorization and funds to launch an exploratory expedition to the upper reaches of the Missouri River and the hitherto unknown Columbia River. While the expedition was presented to the French (from whom the United States subsequently purchased the Louisiana Territory) and the Spanish as merely a scientific enterprise, the Congress authorized it under the authority of the commerce clause of the Constitution. The expedition was funded by a \$2,500 allocation from the War Department budget. (Total federal expenditures in 1803, less debt repayments, amounted to \$7.8 million.)

Precedents set by the expedition included not only government support of exploration (with mixed and occasionally covert motives), but the notion that just "getting there" was not enough. In his instructions to Lewis and Clark, Jefferson insisted on carefully recorded astronomical observations, natural history, and accounts of Indian life encountered along the way.

**U.S. Coast Survey (1807, 1818, 1832):**

Yielding to pressure from commercial interests on the Eastern seaboard, as well as the Treasury Department's need to locate choice sites for lighthouses, the U.S.

Congress in 1803 authorized a survey of the entire U.S. East Coast. The Congress authorized \$50,000 (twenty times the appropriation for the Lewis and Clark expedition) for the survey. The Treasury Department was to administer the survey and asked Ferdinand Rudolph Hassler, a Swiss geodesist, to carry it out. Hassler did not begin work until 1816 and had to stop two years later when an ambitious military chaplain pointed out that the authorizing legislation specified that only U.S. military or naval officers could be employed by the Survey. The survey stopped in 1818 and was not resumed again until 1832 when the Congress relented and authorized employment for the Survey of anyone deemed qualified. Interbureaucratic warfare intervened as President Jackson was persuaded in 1834 to transfer the Survey to the Navy Department. Hassler resisted, his friends lobbied the White House, and the Survey was returned to the Treasury Department in 1836.

#### **The U.S. Exploring Expedition (1838-1842):**

Casting covetous eyes on the South Pacific, American merchants and whalers persuaded the Navy Department during John Quincy Adams' presidency to plan a Pacific expedition to collect information about the region's geodesy, geography, geology, flora, fauna, and natural resources. Added to these motives was the eagerness of an eccentric Navy Captain, John Cleves Symmes, to prove his curious hypothesis that the Earth consisted of a series of concentric hollow spheres accessible through the North and South Poles. The election of Andrew Jackson in 1828 aborted the Navy's scheme, but did not curtail the successful lobbying efforts of a Symmes follower, Jeremiah N. Reynolds. Justifying the expedition on the grounds of the Constitution's commerce clause, and appealing to national pride in the face of British and French expeditions to the Antarctic and elsewhere, Reynolds successfully rallied American scientists and commercial interests to persuade the new president to support the expedition--

now expanded to include hydrography, magnetism, meteorology, and natural history. Jackson signed a bill authorizing the U.S. Exploring Expedition in May 1836 and authorized Navy expenditures of up to \$150,000 in addition to the \$150,000 directly appropriated.

By the time the expedition was ready (1838), Jackson had been replaced by Martin Van Buren and Joel R. Poinsett was named Secretary of War. Poinsett's interest in the expedition was primarily scientific; he insisted that the expedition be a peaceful one "to extend the bounds of human knowledge." The Navy's role was limited to transporting the expedition and a junior officer--Lieutenant Charles Wilkes--was selected to head the expedition on the grounds of his scientific qualifications. Four years later the expedition returned, bringing with it an enormous treasure of information about the ethnology, anthropology, zoology, geology, meteorology, botany, hydrography, and physics of Latin America, the Antarctic, the Central Pacific Islands, and the western coast of America. The nautical charts developed by the expedition were still in use by the U.S. Navy during World War II.

#### **U.S. Topographical Surveys (1824- ):**

Jefferson's interest in geographical exploration was sustained by Secretary of War John C. Calhoun (1817-1825). Calhoun revived the Army's interest in trans-Mississippi exploration, dispatching Major Stephen H. Long on an ambitious Missouri expedition. Like Jefferson, Calhoun stressed the scientific aspect of the expedition, instructing Long to make and record careful observations not only of the region's topographical characteristics, but of its vegetation, geology, and the Indians of the Plains and Rockies. In 1824 Calhoun created a centrally directed Corps of Topographical Engineers within the War Department. The Corps conducted innumerable topographical expeditions--often in parallel with military operations--in the American

West during the 19th century. Among the best known are the Far Western and Oregon Trail surveys conducted by Lt. John Charles Fremont, whose work encompassed astronomy, geology, and natural history as well as topography.

In 1878 the country's several Surveys were consolidated into the U.S. Coast and Geodetic Survey--still in the Treasury Department. The next year the Congress established the U.S. Geological Survey in the Department of the Interior. The exploration of the American West by the government was marked by intense rivalries among exploring teams and their government sponsors as well as Congressional allies. At the same time, the opening of America's western frontier would not have been possible without these exploring expeditions which, helped by the scientific interests of some of their patrons, gathered an important harvest of information about the terrain and natural history of the West.

#### Development of the Nation's Transportation and Energy Networks

The proper role of the federal government in developing the nation's transportation and energy networks has been an issue in American politics since the early 19th century. As successive migrations moved westward in search of more and better land, western politicians pressed for government aid for "internal improvements"--principally roads and canals. During the early part of the century the "American System," advocated by Henry Clay of Kentucky, would promote American economic development through internal improvements financed by a protective tariff and a national bank providing banknote currency of uniform value. The War of 1812 made more urgent the need for a good internal transportation system for interstate commerce as well as national defense.

Constitutional scruple, however, inhibited direct federal involvement in the creation of a national transportation network until that network actually became

national in character. President James Madison vetoed a bill (1817) which would have distributed federal funds to the states for local internal improvements. President Andrew Jackson in 1830 also vetoed a similar bill to subsidize the construction of a 60-mile road from Maysville on the Ohio River to Lexington, Kentucky. Both believed that the federal government was constitutionally prohibited from funding local internal improvements. Instead, private enterprise and individual state governments bore most of the burden of building roads and canals. The federal government did, however, indirectly subsidize river and harbor improvements and the building of railroads by contributing the labors and know-how of the Corps of Engineers.

With the coming of the railroads, commercial air transportation, and the automobile and trucking industry, the extent and quality of U.S. transportation networks did become an issue of national scope, and the role of the federal government in improving them substantially changed.

#### **Railroads:**

The construction and consolidation of the U.S. railroad network throughout the eastern half of the nation up to 1850 depended primarily on private American and European investment. Western railroad builders after mid-century turned successfully to local and state governments for help through subsidies, loans, and stock subscriptions. Although most efforts to obtain direct federal subsidies for a transcontinental railroad foundered (before the Civil War) on sectional rivalries, the Congress, in 1850, passed the first of several bills providing the first of many railroad land grants. (Recall that federal government during the early 19th century had already met the expense of the necessary first phase for the spread of a national transportation network by conducting national land and topographical surveys.)

The absence of the South from national politics during the Civil War enabled the Congress to pass the Homestead Act of 1862, the first in a series of land, timber and desert acts which transferred large portions of the public domain into private hands in exchange for development promises. Ostensibly a boon to the small independent farmer, the principal beneficiaries of the act were large railroad and timber interests.

By the end of the century railroad companies had received over 131 million acres from the public domain, which they used principally as credit and security for bond issues. About a third of the investment in the railroad network came from European (mostly British) sources. The federal government also loaned about \$65 million to six Western railroads. A hidden subsidy--which also meant savings for the government--occurred in the form of conditions attached to land grants requiring the railroads to supply cheap transportation for mail and military transport. The economic return to the country from the federal government's subsidies is incalculable.

#### **Panama Canal:**

A canal across the isthmus of Panama had been a dream since the 17th century and a fixture in American diplomatic history since the middle of the 19th century. In 1876 Colombia sold a French organization the right to build a canal across Panama, but notwithstanding the promotional skills of Viscount Ferdinand deLesseps (builder of the Suez Canal), the French venture ended only in bankruptcy, \$260 million lost, and a French prison sentence for deLesseps (not served) for misappropriation of funds. Disappointed French investors reconnoitered, placed their funds in the tender care of American financier J.P. Morgan, and schemed to sell the group's dubious assets to the United States. In a malodorous series of events, the U.S. Congress directed President Theodore Roosevelt to acquire the necessary strip of land from Colombia and the

French-owned Panama Canal Company's assets for no more than \$40 million. When Colombia demurred, it found itself in the midst of an insurrection (encouraged by the United States) after which it was forced to recognize an independent Republic of Panama. The new Republic promptly ceded the canal zone to the United States.

Over 50 miles long, the Panama Canal is one of the two most strategic artificial waterways in the world. It was opened for commercial traffic in 1914 and formally completed six years later. A lake-and-lock type canal, the canal shortens voyages between the Atlantic and Pacific oceans (around Cape Horn) by about 8,000 nautical miles. Built by the federal government through the U.S. Isthmian Canal Commission, the Panama Canal is generally considered one of the great engineering feats of the world; its cost is estimated to have been about \$375 million (federal expenditures for the year 1914, less debt repayment, were about \$735 million). The acquisition of the Panama Canal zone is considered one of the darkest chapters in American diplomatic history and should be so remembered when one evokes the Panama Canal as a "great" American achievement.

During the 19th century national politicians hesitated, on constitutional grounds, to use federal money for local or state "improvements." By the early 20th century, however, what had served as a restriction became a license, as the expanding transportation needs of a growing national economy could no longer be met by local communities and private enterprise.

#### **Waterways and the U.S. Merchant Marine:**

Though the relative costs of inland water transport and other forms of transport are difficult to calculate, Americans have shared a strong belief that water transportation is cheap and access to good water routes an "open sesame" to local prosperity. (Hence "rivers and harbors" legislation has been one of the most lively

arenas for pork-barrel politics.) By the end of the 19th century the railroads had largely replaced the country's network of local canals; the most significant U.S. water transportation occurred on the Great Lakes and the coastwise and intercoastal routes. The largest federal appropriations went to the river systems and the intracoastal canals along the Atlantic and Gulf coasts, where the U.S. Corps of Engineers had, by 1960, spent over \$5 billion to dredge channels and harbors, build dams and locks to maintain water depths, and build revetments.

In 1924 the federal government created the Inland Waterways Corporation (IWC) as an experiment to demonstrate the feasibility of river-borne commerce (largely shipment by barge). The Federal Barge Lines, the operating arm of the IWC, was to be sold to the private sector once the worth of river-borne transportation had been demonstrated. However, during much of its 29 years of operations, the Federal Barge Lines showed operating losses--primarily the result of the Lines' low charges (which were less than private operators') and routes to out-of-the-way points. Nonetheless the possibility of profitable operation was sufficiently shown for the Lines to be sold for \$9 million in 1953 to the St. Louis Shipbuilding and Steel Company, which had to supply the same service furnished by the Federal Barge Lines. The newly formed private company--Federal Barge Lines, Inc., was able to make the barge lines pay by modernizing equipment, reducing personnel and terminal operations, and abandoning non-paying points of call.

Improvements in marine technology and increased shipping to European belligerents during World War I brought about a sharp rise in American foreign shipping. But as losses of ships to the Germans during the war exceeded even the minimum necessary to meet wartime needs, the U.S. government was forced to get into the shipping business. The Congress created a U.S. shipping board in 1916 and appropriated \$50 million to buy new ships. Once the United States actually entered the war, the board established the

Emergency Fleet Corporation with \$4 billion to spend on new construction. The Emergency Fleet Corporation added over 2 million tons to the U.S. merchant fleet by the war's end. With the Merchant Marine Act of 1920 the federal government sold its merchant fleet to the private sector, to which it then provided indirect subsidies through payments for mail transport.

In 1936 the Congress, with the creation of the U.S. Maritime Commission, began a policy of direct subsidies (operating differential subsidies) to enable the U.S. merchant fleet to compete with foreign commercial shipping. Still, when the United States entered World War II the U.S. merchant fleet was inadequate to the needs of military transport, and the Congress authorized the construction, on government account, of the "Liberty" and "Victory" ships that transported soldiers, goods, and materiel to the European theater. (Hundreds of these ships were sold at less than cost to private American-flag operators after the war under the Merchant Ship Sales Act of 1946.)

#### **Air Transportation System:**

Use of aircraft during World War I was the principal stimulus behind the creation in 1915 of the National Advisory Committee for Aeronautics (NACA), which inaugurated a federal policy of direct involvement in the long-term development of a major U.S. transportation system. Both military and civilian needs for aeronautical research and development would be met by the NACA, one of the federal government's first nonmilitary research and development institutions. The commercial promise of the airplane did not, however, become apparent until the 1920s.

With the Air Commerce Act of 1926 the federal government promptly initiated a policy of direct federal involvement in building a national transportation network for the new airline industry. Having subsidized air transportation indirectly since

1918 by paying aircraft operators to carry the U.S. mail, the government began to establish air routes first with beacon lights and then with radio markers and radio range beacons. Between 1949 and 1960 the federally owned system of air routes (made up of VHF airways and "superskyways" above the 17,000 ft. level) in the U.S. and its territories grew from 57,000 to 220,000 miles. The system included navigational aids, instrument approach systems, emergency landing fields, air-route traffic control centers, weather reporting services, and traffic control facilities at major airports. Between 1925 and 1961 the federal government spent around \$3 billion on the construction and maintenance of U.S. airways.

Private investors and municipalities were expected to bear the burden of airport construction until 1933, when the federal government's depression-era relief policy prompted direct government aid; in seven years the federal government contributed more than 70 percent of the funds spent on airport construction. In 1940 the Congress authorized an extension of airport facilities, but, with U.S. entry into World War II, military considerations determined the nature and location of U.S. investment in airport construction. The Federal Airport Act of 1946 was a congressional effort to inject order and planning in U.S. support of the nation's infrastructure for air transportation by providing federal funding for airport construction. States received 75 percent of available funds, allocated by population and area, while the government bore 50 percent of the costs for small airports (excluding land acquisition). Federal support for airport construction was administered under the National Airport Plan of the Civil Aeronautics Administration (CAA) of the Department of Commerce. The CAA and the Civil Aeronautics Board were replaced in 1958 by an independent agency, the Federal Aviation Administration, which was given control of all the nation's physical facilities for civil aviation.

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**Interstate Highway System:**

The condition of American roads when automobiles, buses, and trucks began to travel over them in significant numbers was deplorable. Motorists would move over brief stretches of pavement only to find themselves stopped dead in mud gullies and dust swirls "in the middle of nowhere." Few localities could afford to build well-paved highways of any length, much less connect reliable interstate roads. The American Automobile Association combined lobbying forces with the American Association of State Highway Officials, the American Road Builders Association, and legislators from rural regions to force passage in 1916 of the Federal Aid Road Act. With this legislation the Department of Agriculture was directed to spend \$75 million to build rural post roads over a period of five years--the federal contribution limited to 50 percent of total cost (excluding bridges and other major structures)--on the condition that the states organize highway departments with adequate staffs and budgets to maintain the roads.

Under the Federal Highway Act of 1921 (which gave preference for federal funds to states that had designated federal highway systems), the Congress appropriated five times the sum, or \$375 million, for a single year's construction (1922) as it had for the 1916-1921 period. As with airport construction, the Depression gave an added impetus to federal spending; by 1932 federal funds accounted for 40 percent of total revenues spent on roads. Road construction necessarily dwindled during World War II, a lapse which the Congress sought to rectify with the Federal Aid Highway Act of 1944. This Act made \$1.5 billion available for three years after the War to begin construction of an interstate highway system (of not over 40,000 miles).

There is nothing like responsibility for successful military operations to direct attention to the importance of a reliable transportation system. Just as the War of 1812 stimulated the U.S. government's interest in surveying the nation's frontier and

waterways, President Dwight D. Eisenhower--recalling the lessons of his own military training and command (and probably the conditions of the roads in the Kansas of his boyhood)--understood the need for a good national transportation network. In 1956, he signed legislation creating the Interstate and Defense Highway System. The system was designed to lay 41,000 miles of limited-access, multi-lane highways, built to military specifications and connecting the principal population centers of the United States. Initially the federal government provided 90 percent of the money for the system, which is now paid for through a "highway trust fund," partially financed with excise taxes on petroleum products, tires, and trucks.

Between 1917 and 1960 the federal government directly supported, through government agencies and appropriations, the building of the modern U.S. transportation network by an amount in excess of \$33 billion. The largest proportion of this amount was spent through authorizations for federal aid to highways (\$20 billion), the U.S. Army Corps of Engineers (\$5 billion), the Federal aviation program (\$4.5 billion for the Civil Aeronautics Board and Federal Aviation Administration), and the U.S. Coast Guard (\$1.6 billion). Historians generally agree that American public policy has tended to "push" the U.S. transportation network development ahead of demand, with a predictable diminution of market discipline in American transportation industries. Whether the benefits of this policy to the nation and particular localities and regions have nonetheless outweighed its costs is a matter of political choice and historical judgment.

#### **Tennessee Valley Authority:**

The work of building the country's energy network has been largely the work of private enterprise, which laid pipelines and built hydroelectric dams and power grids (with considerable help from state bond authorities and the U.S. Army Corps of

Engineers.) The best known exception has been the Tennessee Valley Authority (TVA). The TVA was created in 1933, in the depths of the Depression, to harness technology for social betterment in one of the most economically depressed areas of rural America. The TVA was to promote planned social improvement by constructing multipurpose dams to generate cheap hydroelectric power and provide flood control; manufacturing fertilizer; digging a 650-mile navigation channel from Knoxville to Paducah; and engaging in soil conservation and reforestation.

Although the TVA never achieved the idyllic social transformation envisioned by its idealistic supporters, it was--until the era of nuclear power plant construction--generally considered a success as a technology development program with important social benefits. In 1932 the number of farms with electricity in Tennessee, Alabama, Mississippi, and Georgia ranged from between 1 in 25 to 1 in 50. By the early 1940s 1 in every 5 farms in the region was electrified. The TVA's success in bringing electrification to the depressed Tennessee Valley region was partly due to its approach to setting power rates. Under David E. Lilienthal the TVA pursued a dynamic policy of setting low rates to stimulate use instead of lowering rates only on the basis of increased use, as was then the practice among private utilities. (The "energy crisis" of the 1970s discredited the policy of promoting the use of electricity.)

Many also attribute the TVA's success to the degree of administrative and fiscal latitude it was given (compared to most federal organizations) in its enabling legislation. For example, the TVA was given broad general authorization to construct projects along the Tennessee River and its tributaries. The TVA therefore did not need to submit each project to a protracted annual process of congressional authorization, presidential approval, and the congressional appropriations process. Instead, it needed only a single congressional action, initiated through an

appropriations committee, to begin a project. The TVA was also left free to manage its own revenues and budgets, thus avoiding the constant intrusion of congressional politics. Revenues generated by the TVA have been deposited in a special account in the U.S. Treasury and may be reinvested or applied to TVA's operating budget, as the TVA sees fit.

The Congress in 1933 had not intended the TVA to be a source of revenue for the government, but it did stipulate that TVA's power operations be "self-supporting" and "self-liquidating." The Appropriations Act of 1948 required repayment of Treasury funds invested in TVA power facilities within 40 years after those facilities were placed in service. During the first twenty years of its existence the TVA averaged an annual return on investment of more than 4 percent. Amendments in 1940 to the basic Act required the TVA to make in-lieu-of-taxes payments equivalent to 5 percent of total power revenues to the counties and states in the region. In the early 1950s these payments by the TVA and its local distributors amounted to 6.5 cents of every dollar of gross revenue from power sold to municipal and cooperative systems. By way of comparison, the 13 privately owned utilities serving adjacent areas paid state and local taxes averaging 7.8 percent.

In recent years the TVA has been criticized for "bureaucratic ossification," for its ill-fated emphasis on nuclear power generating, and--by conservationists--for ecological neglect. It has always been an object of political assault from the private utility industry. Nonetheless, the TVA remains a model of direct government-involvement in regional resource development, one widely copied in Europe and in the developing nations.

#### Summary

Since the earliest days of the Republic the people of the United States have generally foresworn allowing the federal government to compete with private

manufacturing and commerce. They have allowed the government to operate military arsenals and exercise exceptional influence over private industry only in times of national emergency. At the same time, however, the federal government has been permitted--indeed, often directed--to take up those tasks essential to national economic growth that localities and private industry themselves could not sustain. This, through a great variety of administrative and fiscal devices, the government has done. Paramount among them was the need to explore and survey the vast American frontier and to take an active role in the development of the nation's transportation and energy networks. As the United States crosses into the next frontier of Space in the 21st century, its own history provides ample precedent for continuing government leadership in the exploration and occupation of this vast region beyond the Earth.

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